

Appendix C-B

Potential Evaporation and Potential Transpiration Calculations

Given multiple values of van Genuchten retention curve parameters, calculate a set of parameters that will yield mean, max and min water contents from the implied curves.

Alpha should be input in cm⁻¹:

	1	2	3	4	5
1	0	"ThetaR"	"ThetaS"	"Alpha"	"n"
2	"Drum #1"	0.02	0.44	0.012	1.23
3	"Drum #2"	0.05	0.52	6.8·10 ⁻³	1.4
4	"on CACH 205"	0.06	0.53	4.3·10 ⁻³	1.37
5	"op of Column"	0	0.51	0.01	1.23
6					

Van Genuchten parameters obtained from
soil moisture retention measurements of
Column samples of SAB sediment:

	1	2	3	4	5
1	0	"ThetaR"	"ThetaS"	"Alpha"	"n"
2	"D30C1"	0.141	0.488	0.013	1.417
3	"D30C2"	0.025	0.482	0.07	1.172
4	"D30C3"	0	0.491	0.038	1.165
5	"D60C1"	0.121	0.466	0.018	1.337
6	"D60C2"	0.107	0.495	0.021	1.315
7	"C60C3"	0.052	0.485	0.028	1.24
8	"D90C1"	0	0.491	0.046	1.154

Van Genuchten parameters obtained from
soil moisture retention measurements of
EBTF samples of SAB sediment:

	0	1	2	3	4
0	0	"ThetaR"	"ThetaS"	"Alpha"	"n"
1	"226 10-10.5"	0.026	0.286	0.313	1.252
2	"248 10-10.5"	0.033	0.332	0.172	1.469
3	"226 19-20"	0.052	0.225	0.112	1.544
4	"248 18-18.5"	0.06	0.37	0.047	2.025
5	"251 19-19.5"	0.027	0.348	0.123	1.327
6	"252 20-23"	1·10 ⁻⁴	0.321	0.796	1.208
7					

Van Genuchten parameters obtained from
soil moisture retention measurements of
INTEC samples of alluvium:

I := length(Data $\langle 1 \rangle$) I = 40

i := 1..I

Define the dataset and indices for vectors and plotting parameters:

Data := submatrix(Data, 2, 1, 2, 5)

I := length(Data $\langle 1 \rangle$)

I = 39

i := 1..I

j := 1..35 h_j := 10 $\frac{j-11}{5}$

Assign names to columns of data and examine the data values

$\theta_{r_i} := (\text{Data } \langle 1 \rangle)_i$ $\theta_{s_i} := (\text{Data } \langle 2 \rangle)_i$ $\alpha_i := (\text{Data } \langle 3 \rangle)_i$ n_i := (Data $\langle 4 \rangle$)_i

min(θ_r) = 0 min(θ_s) = 0.429 min(α) = 9.7×10^{-3} min(n) = 1.13

max(θ_r) = 0.15 max(θ_s) = 0.508 max(α) = 0.07 max(n) = 1.441

$\theta_{\bar{r}\mu} := \text{mean}(\theta_r)$ $\theta_{\bar{s}\mu} := \text{mean}(\theta_s)$ $\alpha_{\bar{\mu}} := \text{mean}(\alpha)$ $n\bar{\mu} := \text{mean}(n)$

$\theta_{\bar{r}\mu} = 0.061$ $\theta_{\bar{s}\mu} = 0.471$ $\alpha_{\bar{\mu}} = 0.026$ $n\bar{\mu} = 1.245$

Define the least-squares condition and constraints and solve for parameters giving mean water content function of pressure:

Given

$$\overrightarrow{\left[\theta_{\text{r}\mu} + (\theta_{\text{s}\mu} - \theta_{\text{r}\mu}) \cdot [1 + (|\alpha\mu \cdot h|)^{\eta\mu}] \right] - \left(1 - \frac{1}{n\mu} \right)} = \frac{\sum_i \left[\theta_{\text{r}_i} + (\theta_{\text{s}_i} - \theta_{\text{r}_i}) \cdot [1 + (|\alpha_i \cdot h|)^{\eta_i}] \right] - \left(1 - \frac{1}{n_i} \right)}{1} \quad \alpha\mu > 1 \quad n\mu > 1.01$$

$$\begin{pmatrix} \theta_{\text{r}\mu f} \\ \theta_{\text{s}\mu f} \\ \alpha\mu f \\ \eta\mu f \end{pmatrix} := \text{Minerr}(\theta_{\text{r}\mu}, \theta_{\text{s}\mu}, \alpha\mu, \eta\mu) \\ \begin{pmatrix} \theta_{\text{r}\mu f} \\ \theta_{\text{s}\mu f} \\ \alpha\mu f \\ \eta\mu f \end{pmatrix} = \begin{pmatrix} 0.038 \\ 0.475 \\ 0.03 \\ 1.186 \end{pmatrix}$$

$$\theta(\theta_r, \theta_s, \alpha, n, h) := \theta_r + (\theta_s - \theta_r) \cdot [1 + (|\alpha \cdot h|)^n] - \left(1 - \frac{1}{n} \right)$$

Define the least-squares condition and constraints and solve for parameters giving minimum water content function of pressure:

$$\overrightarrow{\left[\theta_{\text{r}_{\text{data}}, j} + (\theta_{\text{s}_j} - \theta_{\text{r}_j}) \cdot [1 + (|\alpha_j \cdot h_j|)^{\eta_j}] \right] - \left(1 - \frac{1}{n_j} \right)} \\ \min \theta_j := \min(\theta_{\text{data}}^{\langle j \rangle}) \quad \max \theta_j := \max(\theta_{\text{data}}^{\langle j \rangle})$$

Given

$$\overrightarrow{\left[\theta_{\text{r}\mu} + (\theta_{\text{s}\mu} - \theta_{\text{r}\mu}) \cdot [1 + (|\alpha\mu \cdot h|)^{\eta\mu}] \right] - \left(1 - \frac{1}{n\mu} \right)} = \min \theta \quad \alpha\mu > 1 \quad n\mu > 1.01$$

$$\begin{pmatrix} \theta_{rMinf} \\ \theta_{sMinf} \\ \alpha_{Minf} \\ nMinf \end{pmatrix} := \text{Minerr}(\theta_{r\mu}, \theta_{s\mu}, \alpha\mu, \eta\mu)$$

$$\begin{pmatrix} \theta_{rMinf} \\ \theta_{sMinf} \\ \alpha_{Minf} \\ nMinf \end{pmatrix} = \begin{pmatrix} 0.008 \\ 0.434 \\ 0.042 \\ 1.197 \end{pmatrix}$$

Define the least-squares condition and constraints and solve for parameters giving maximum water content function of pressure:

Given

$$\left[\theta_{r\mu} + (\theta_{s\mu} - \theta_{r\mu}) \cdot [1 + (|\alpha\mu \cdot h|)^{\eta\mu}] \right] - \left(\frac{1}{1 - \frac{1}{\eta\mu}} \right) = \max\theta$$

$$\theta_{r\mu} > 0 \quad \alpha\mu > 0 \quad \eta\mu > 1.01$$

$$\begin{pmatrix} \theta_{rMaxf} \\ \theta_{sMaxf} \\ \alpha_{Maxf} \\ nMaxf \end{pmatrix} := \text{Minerr}(\theta_{r\mu}, \theta_{s\mu}, \alpha\mu, \eta\mu)$$

$$\begin{pmatrix} \theta_{r\mu f} \\ \theta_{s\mu f} \\ \alpha_{\mu f} \\ n_{\mu f} \end{pmatrix} - \begin{pmatrix} \theta_{rMinf} \\ \theta_{sMinf} \\ \alpha_{Minf} \\ nMinf \end{pmatrix} = \begin{pmatrix} 0.03 \\ 0.041 \\ -0.011 \\ -0.011 \end{pmatrix}$$

$$\begin{pmatrix} \theta_{rMaxf} \\ \theta_{sMaxf} \\ \alpha_{Maxf} \\ nMaxf \end{pmatrix} - \begin{pmatrix} \theta_{r\mu f} \\ \theta_{s\mu f} \\ \alpha_{\mu f} \\ n_{\mu f} \end{pmatrix} = \begin{pmatrix} 0.072 \\ 0.032 \\ -0.004 \\ 0.056 \end{pmatrix}$$

$$\begin{pmatrix} \theta_{r\mu f} \\ \theta_{s\mu f} \\ \alpha_{\mu f} \\ n_{\mu f} \end{pmatrix} = \begin{pmatrix} 0.111 \\ 0.508 \\ 0.026 \\ 1.242 \end{pmatrix}$$

$$\begin{pmatrix} \theta_{r\mu f} \\ \theta_{s\mu f} \\ \alpha_{\mu f} \\ n_{\mu f} \end{pmatrix} = \begin{pmatrix} 0.072 \\ 0.032 \\ -0.004 \\ 0.056 \end{pmatrix}$$

$$\begin{pmatrix} \theta_{rMaxf} \\ \theta_{sMaxf} \\ \alpha_{Maxf} \\ nMaxf \end{pmatrix} = \begin{pmatrix} 0.111 \\ 0.508 \\ 0.026 \\ 1.242 \end{pmatrix}$$



